PATENT ABSTRACTS OF JAPAN

(11)Publication number : 62-093915
(43)Date of publication of application : 30.04.1987

(51)Int.Cl. H01F 10/00

(21)Application number : 60-234971
(22)Date of filing : 21.10.1985

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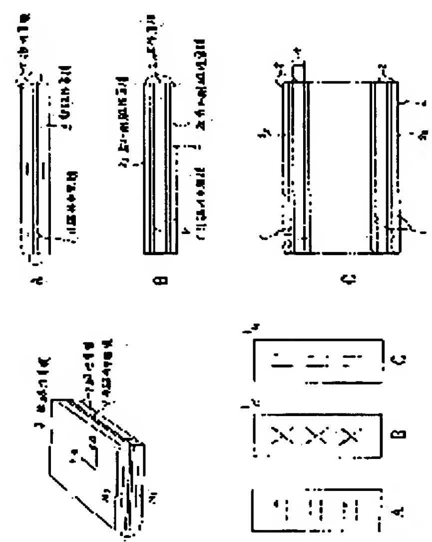
(54) MAGNETICALLY SOFT THIN FILM

(57)Abstract:
PURPOSE: To prevent the generation of Barkhausen noise by a method wherein a magnetic thin film is laminated through the intermediary of a non-magnetic intermediate layer.
CONSTITUTION: A magnetically soft thin film 2 is laminated in two or more layers through a non-magnetic intermediate film 1 as shown by the structures AWC in the diagram. The thickness of the film 1 is selected in the range of 5W104Å, and a static magnetic action is dominant between the adjoining two films 2. The proper saturated magnetic flux density and thickness are selected for the films 2 with the axis of easy magnetization in the same direction, and the total magnetic flux is closed. In the structure A, when the films 2 are made of the same material, they are formed in the same thickness, the amount of magnetic flux of both films are brought in coincidence with each other, and the magnetic flux is closed as a whole. In the structures B and C, all the films 2 including the magnetic thin film 2S located on the outermost side are made of the same material, the film 2S only is formed in the thickness of t/2, and other films 2 are formed in the thickness of (t). When the outside magnetic field is intensified on the magnetically soft thin film 3 in the direction (ha) of the axis of difficult magnetization, the films 2 are finally magnetized in the same direction from the state of anti-parallel magnetization, and at this time, a rotation due to magnetization is generated on the plane, no magnetic wall is generated, and the generation of the Barkhausen noise can be prevented.



LEGAL STATUS
[Date of request for examination]
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[Date of final disposal for application]
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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Industrial Application]
this invention relates to the magnetic artificial grid film suitable for the magnetic pole of the magnetic head for magnetic recording media.
[Description of the Prior Art]
For example, if it is going to make recording density, such as magnetic-file equipment, high, in order to have the high saturation magnetic flux density Bs which can fully magnetize a magnetic-recording medium by the magnetic-head side using what has the big coercive force Hc to a magnetic-recording medium and to converge the leakage flux from a magnetic-recording medium efficiently, it has good soft magnetic characteristics, and the magnetic material which can control magnetic-domain structure is needed.
As the magnetic head with which are satisfied of such conditions, the ring-type head which machines a ferrite and is obtained has been used by the former. However, since a raise in saturation magnetic flux density and micro processing have approached the limitation, the thin film magnetic head obtained by the ultra-fine processing technology adapting the Fort Lee SOGURAFU technology and thin film-ized technology is used now.
[Problem(s) to be Solved by the Invention]
It is difficult ****** that coercive force Hc records a magnetization signal on the high holding power medium of 1000 or more oersteds since saturation magnetic flux density is about one tesla although the NiFe alloy by vacuum deposition, the spatter, or plating has been conventionally used for such a magnetic pole film for the thin film magnetic heads.
Although Fe film is promising as a film of high saturation magnetic flux density which replaces a NiFe alloy, since magnetic-domain structure suitable for the magnetic pole film cannot be taken, if coercive force is large, and it remains as it is, it cannot be used as a magnetic pole film. Moreover, there is a fault of being easy to oxidize in air, and it has been an obstacle on the occasion of utilization.
On the other hand, as the method of soft-magnetism-ized magnetic-domain structure control of Fe film, Fe is made into a host and there is a method in which the second element, such as C or Si, is made to mix as a guest (example : Bozorth work "FERROMAGNETISM", D.V.Nostrand Co.).
However, by this method, since C and Si are non-magnetic material, there is a fault that saturation magnetic flux density Bs falls. moreover, the thing for which Fe film is formed in nitrogen-gas-atmosphere mind by the spatter -- good soft magnetic characteristics -- becoming (example : J.Appl.Phys. 61p3841 ('87)) -- this film has the problem that thermal stability is missing
Then, it has good soft magnetic characteristics (holding power Hc is small) by the high saturation magnetic flux density replaced with these films, and the ferromagnetic which was [that magnetic-domain structure control is possible (magnetostriction constant lambdas**0), and it is moreover hard to oxidize] excellent also in ** and thermal stability is demanded strongly.
By the way, although research of new materials is done briskly recently, especially an artificial grid film has the very thin thickness of each class, and in order that the property of original of the material which

constitutes them by carrying out the laminating of those films periodically may show a different property, the property of bulk attracts attention also the research side of physical properties, or in respect of application as matter in which a completely different new property is shown again.
this invention is it having been made in view of a point which was mentioned above, the purpose's showing good soft magnetic characteristics by high saturation magnetic flux density, and a magnetostriction constant's being further set to about 0, and offering the magnetic artificial grid film excellent in corrosion resistance and thermal stability simultaneously.
[Means for Solving the Problem]
For this reason, this invention carried out the laminating of Fe layer and the CoFe layer by turns on the substrate, or on the substrate, intervened the CoFe layer, carried out the laminating of Fe layer and the Co layer by turns, and constituted the magnetic artificial grid film.
The laminating of Fe layer and the CoFe layer can be carried out by turns, or the grid film which intervenes and comes to carry out the laminating of the CoFe layer by turns and which changes can also constitute Fe layer and Co layer from this invention as the single magnetic domain is formed by the nonmagnetic insulator layer.
[Function]
Although it is the material currently used from the former if Fe, Co, and CoFe are independent, the interaction between magnetic layers and the crystalline disorder of Fe arise, holding power Hc becomes small, and by carrying out the laminating of these shows good soft magnetic characteristics. Moreover, if each thickness is made into a proper value, magnetostriction constant lambdas can be carried out near zero, and it will become controllable [magnetic-domain structure].
[Example]
Hereafter, the example of this invention is explained. A view 2 shows the deposition equipment for artificial grid film creation. 1 is a target susceptor, it can equip with the target of four sheets and the change of a target of it is attained by rotating this, as an arrow shows. The installation position of a substrate where 2 should carry out deposition formation of the magnetic film on the upper surface, and 3 are the ion sources. It is the point that a degree of vacuum of operation is 1x10 to 4 or less Torrs, and the point which substrate temperature does not go up more than required, and manufacture by the ion beam spatter method is advantageous.
A view 1 is drawing showing the outline structure of the artificial grid film by this invention. The CoFe alloy layer in which Co layer and 6 were formed in of Fe layer, and 5 was formed for 4 of counter diffusion, and 7 are substrates. Thickness of the Co layer 4 and the Fe layer 6 is set to tCotFe, respectively, and tp=tCo+tFe defines a round term tp of an artificial grid.
It considers as tCo=tFe in a view 3, and change of magnetostriction constant lambdas when changing tp is shown. By changing tp (increase), magnetostriction constant lambdas is changing from positive to negative continuously. In spite of being negative that magnetostriction constant lambdas of Co and Fe is not, the whole magnetostriction constant lambdas can take positive or the value of zero. This is because the CoFe alloy layer 5 which has positive magnetostriction constant lambdas in the boundary of the Co layer 4 and the Fe layer 6 was formed.
View 4 (a) The relation between the magnetic-domain structure observed by - (c) by the NiFe alloy single film etc. and the sign (positive, negative, zero) of magnetostriction constant lambdas is shown. By the magnetic pole film of the magnetic head, in order to reproduce the signal from a medium efficiently, it is required to take magnetic-domain structure as shown in a view 4 (b), and it is required to be magnetostriction constant lambdas=0.
Although magnetostriction constant lambdas of Fe and Co is negative as mentioned above, and magnetostriction constant lambdas of a CoFe alloy is positive, since between each magnetic layer is connected magnetically, by the magnetic artificial grid film which was made to carry out the laminating of these and obtained them so that it might become the periodic structure by the repeat, the magnetic-domain structure is determined by the sign of magnetostriction constant lambdas of the whole film like a single film.
The Fe layer membrane thick dependency of magnetostriction constant lambdas is shown in a view 5.

20A, even when 5A of Co layer thickness is any, it is set to magnetostriction constant lambdas=0 by making Fe layer thickness into 150A or more.
The Fe layer membrane thick dependency of coercive force Hc is shown in a view 6. By setting the thickness of Co layer as 5A, coercive force Hc can realize 1.5 oersteds and few good soft magnetic characteristics.
The Fe layer membrane thick dependency of saturation magnetic flux density Bs is shown in a view 7. Since Fe was used as the base, the value (the saturation magnetic flux density Bs of Fe is 2.15 teslas) of about 2.15 teslas was acquired.
The relation between saturation magnetic flux density Bs and Co layer thickness ratio (tCo/tp) is shown in a view 8. A dashed line connects saturation-magnetic-flux-density Bs=1.76 of the saturation-magnetic-flux-density Bs=2.15 tesla and Co of Fe. A data point is above a dashed line, because the CoFe alloy (the saturation magnetic flux density Bs of Co50Fe50 is 2.45 teslas) by counter diffusion was formed.
The Co layer membrane thick dependency of the coercive force Hc at the time of fixing Fe layer thickness to 50A and magnetostriction constant lambdas is shown in a view 9. In order to obtain good soft magnetic characteristics, the thickness of Co layer is understood that it is better to set it as 10A or less to 50A Fe layer. Moreover, it is expected from the situation of change of magnetostriction constant lambdas that the thickness of a Co-Fe counter diffusion layer is about 10A.
Since saturation magnetic flux density Bs is small, and the pure layer of Co has large coercive force Hc and magnetostriction constant lambdas has a negative big value from the above result, it turns out that the magnetic properties of a magnetic artificial grid film are degraded. Therefore, it turns out that a required Co layer is good by the minimum thickness alloyed with Fe layer. Then, the magnetic artificial grid of Fe and Fe/CoFe which used the CoFe alloy for the target is also considered enough.
The example of composition of a Fe/CoFe magnetism artificial grid film is shown in a view 10. The soft magnetic characteristics and the high saturation magnetic flux density Bs beyond it are realizable like a Fe/Co magnetism artificial grid film by changing the thickness of the Fe layer 6 and the CoFe layer 5, and composition of the CoFe layer 5.
The example of composition of the multilayer of the [Fe, Co, CoFe] system artificial grid by this invention and the nonmagnetic insulator of SiO2 and aluminum2O3 grade is shown in a view 11. 8 is a magnetic artificial grid film and 9 is a nonmagnetic insulator layer. Single magnetic-domain-ization of a magnetic film is attained by inserting the nonmagnetic insulator layer 9 between the magnetic artificial grid films 8.
Only namely, in the case of the magnetic artificial grid film of a laminated structure shown in the view 1 or the 10th view Although the stable state where magnetostatic energy is the lowest serves as reflux magnetic-domain structure which consists of a magnetic domain of a large number as the magnetic-domain structure showed in the view 4, therefore it does not become a single magnetic domain in this case but becomes the reflux magnetic-domain structure of many magnetic domains If it is made the multilayer which sandwiched the nonmagnetic insulator layer 9 between the magnetic artificial grid films 8 as shown in the view 11 Magnetostatic bonding strength works between the magnetic artificial grid films 8. by the magnetic artificial grid film of the 1st layer, the magnetization direction by facing the right and the 4th layer by facing the right and the 2nd layer in a view 11 from a front face like facing the left and .... [facing the left and the 3rd layer] The state (the state all magnetization turned [state] to ** on the other hand by each magnetic artificial grid film, i.e., single magnetic-domain structure) where magnetization turned to the opposite direction by turns will be in the stable state where magnetostatic energy is the lowest. Thus, single magnetic-domain-ization of a magnetic artificial grid film is attained with the magnetostatic bonding strength committed between magnetic artificial grid films.
Moreover, as a magnetic film for the magnetic heads, when only a magnetic artificial grid film uses (the membrane structure of a view 1 and a view 10), magnetic-domain structure turns into reflux magnetic-domain structure of many magnetic domains as shown in a view 4. The magnetic-domain structure of (b) in (a) of a view 4, (b), and (c) is the most desirable at the point that the signal from a medium is efficiently reproducible.

On the other hand, if the multilayer of the magnetic artificial grid film 8 and the nonmagnetic insulator layer 9 is used as a magnetic film for the magnetic heads as shown in the view 11, signal regeneration efficiency will improve by the above-mentioned single magnetic-domain-ization further (that is, the much more than (b) of 4 view). If order is attached to the height of signal regeneration efficiency and these relations are shown [Magnetic-domain structure of view 4 (a) and (c)] <[magnetic-domain structure of view 4 (b)] < [the magnetic-domain structure by the composition of a view 11]
It becomes.
Moreover, with the multilayer composition of a view 11, since each magnetic layer becomes thin, an eddy current loss is stopped and the frequency characteristic of permeability can be improved.
Thus, the [Fe, Co, CoFe] system magnetism artificial membrane by this invention can realize good soft magnetic characteristics with magnetostriction constant lambdas zero, and can realize saturation magnetic flux density Bs two teslas or more simultaneously. Moreover, these magnetic artificial grid films are rich in corrosion resistance, and since magnetic properties do not deteriorate in 300 degrees C, membrane formation temperature is excellent also in thermal stability, since they are the composition which sandwiched Fe to Co and/or CoFe.
[Effect of the Invention]
A Fe [by this invention], Co, and CoFe system magnetism artificial grid film as explained above has small coercive force Hc by optimizing each of that thickness at the high saturation magnetic flux density Bs, since the magnetic film whose magnetostriction constant lambdas is zero simultaneously is realizable, by using as a magnetic pole material for the magnetic heads, a high-density signal can be recorded on a high coercive force medium, and there is an advantage that it is also efficiently reproducible.
Moreover, since it is the structure which carried out the laminating of Fe layer and the CoFe layer by turns on the substrate, or intervened the CoFe layer and carried out the laminating of Fe layer and the Co layer by turns on the substrate, and it is rich in corrosion resistance and excels also in thermal stability, there is an advantage which can manufacture magnetic parts, such as the reliable thin film magnetic head, with the sufficient yield.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
The cross section showing [1] the outline of Fe of one example of this invention, Co, and a CoFe system artificial grid film, Explanatory drawing of the deposition equipment for artificial grid film manufacture in a view 2, the property view showing [3] the cycle length dependency of magnetostriction constant lambdas, View 4 (a) Explanatory drawing in which - (c) shows the sign and magnetic-domain structure of magnetostriction constant lambdas, The property view showing [5] the Fe layer membrane thick dependency of magnetostriction constant lambdas, the property view showing [6] the Fe layer membrane thick dependency of coercive force Hc, the property view and octavus view showing [7] the Fe layer membrane thick dependency of saturation magnetic flux density Bs -- saturation magnetic flux density Bs and Co layer membrane -- thick -- the property view showing a relation with a ratio -- The property view showing [9] the Co layer membrane thick dependency of coercive force Hc and magnetostriction constant lambdas, The cross section showing [10] the example of composition of a Fe/CoFe artificial grid film (another example) and a view 11 are cross sections showing the example of composition of the multilayer of a [Fe, Co, CoFe] system artificial grid film and a nonmagnetic insulator layer (still more nearly another example).
1 [.. The ion source, 4 / .. Co film, 5 / .. A CoFe film, 6 / .. Fe film, 7 / .. A substrate, 8 / .. The [Fe, Co CoFe] system artificial latticed layer, 9 / .. Nonmagnetic insulating layer] .... A target susceptor, 2 .. A substrate, 3

[Translation done.]

CLAIMS

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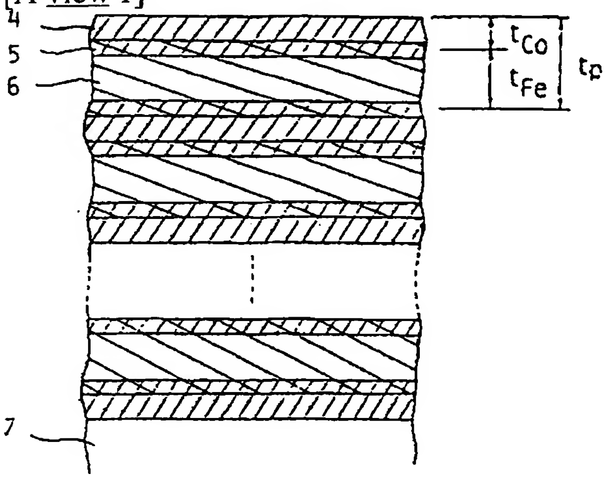
(57) [Claim(s)]
[Claim 1] The magnetic artificial grid film which carries out the laminating of Fe layer and the CoFe layer by turns on a substrate, or is characterized by intervening, carrying out the laminating of the CoFe layer by turns, and changing Fe layer and Co layer on a substrate.
[Claim 2] The magnetic artificial grid film given in the 1st term of a patent claim to which the grid film which carries out the laminating of the above-mentioned Fe layer and the CoFe layer by turns, or intervenes a CoFe layer and comes to carry out the laminating of Fe layer and the Co layer by turns, and which changes considers that the single magnetic domain is formed by the nonmagnetic insulator layer as the feature.

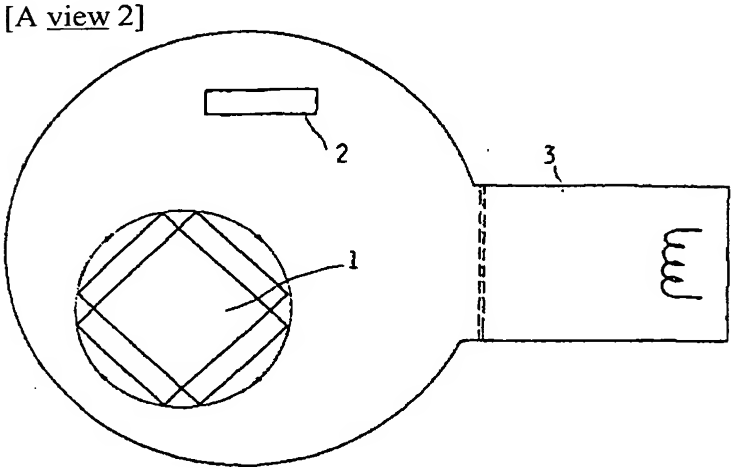
[Translation done.]

DRAWINGS

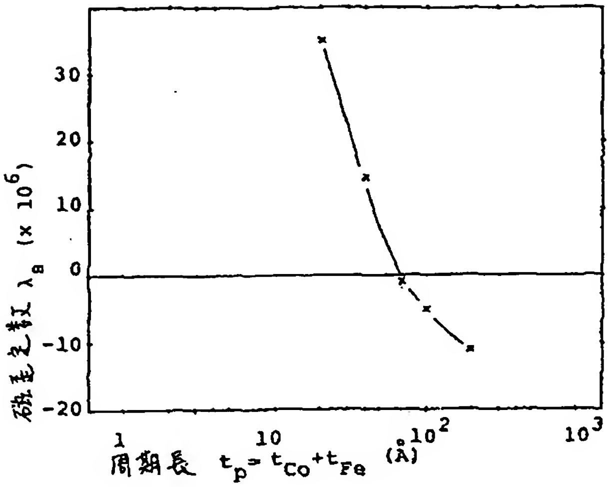
[A view 1]



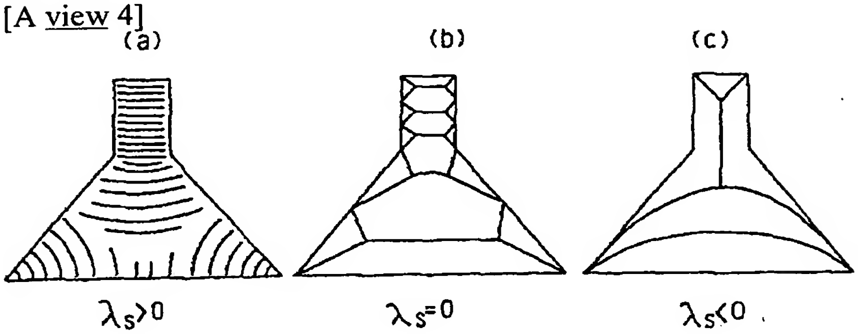
[A view 2]



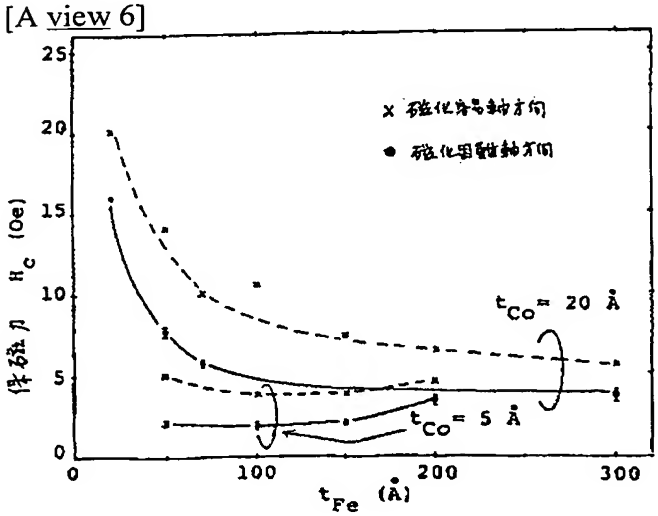
[A view 3]



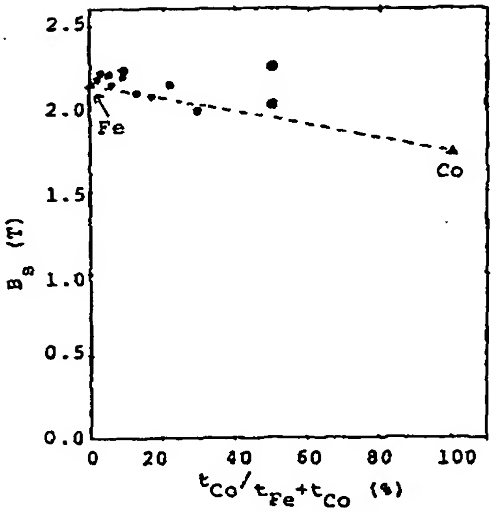
[A view 4]



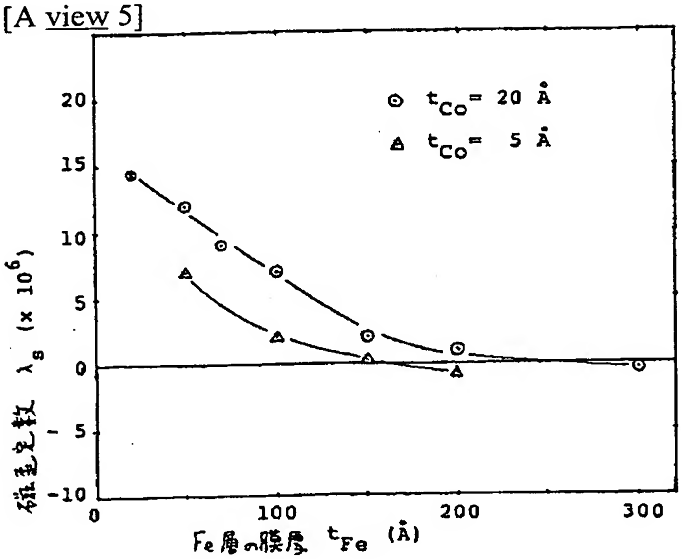
[A view 6]



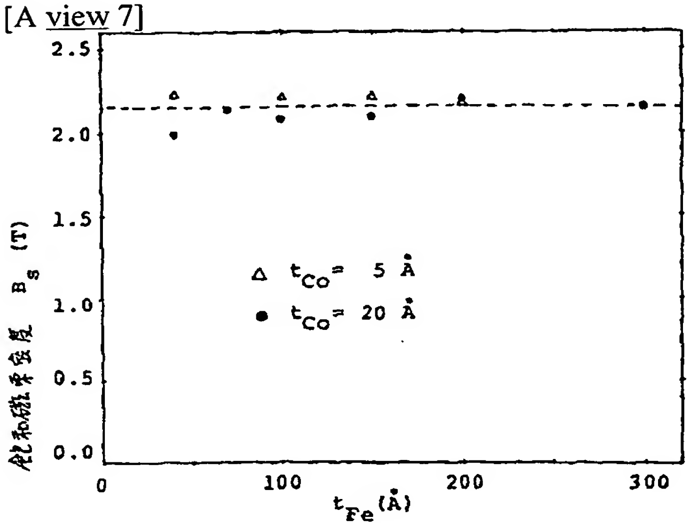
[An octavus view]



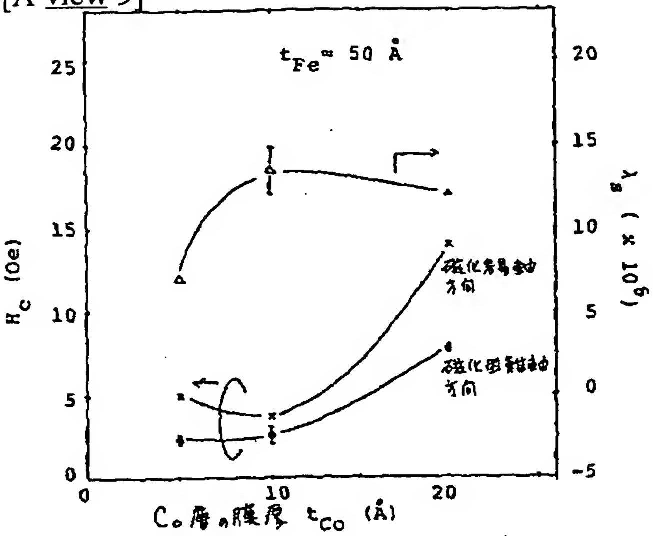
[A view 5]



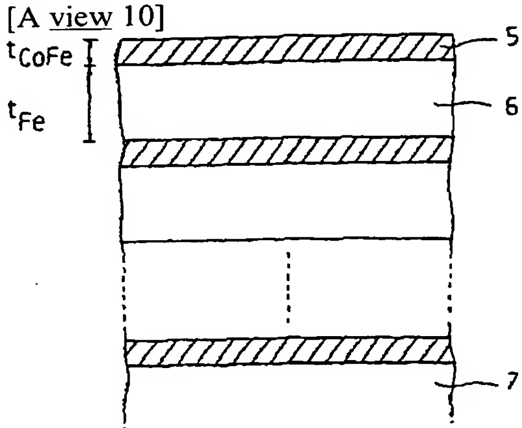
[A view 7]



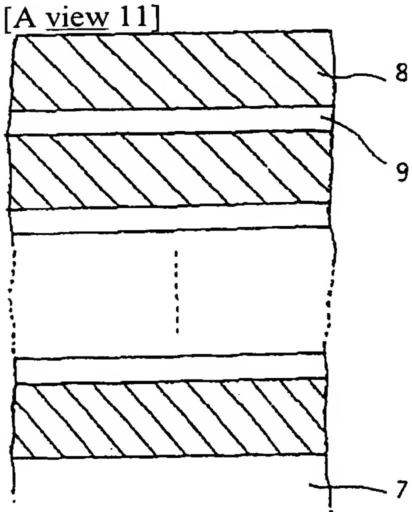
[A view 9]



[A view 10]



[A view 11]



[Translation done.]

(19)日本国特許庁(JP)　(12)特許公報（Ｂ２）　(11)特許出願公告番号

特公平６－６６１８８

(24)(44)公告日　平成6年(1994)8月24日

(51)Int. Cl.⁵	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｈ０１Ｆ　10/00				
// Ｇ１１Ｂ　5/31	Ｃ	8947－５Ｄ		

発明の数　1　（全５頁）

(21)出願番号　特願昭60-234971

(22)出願日　昭和60年(1985)10月21日

(65)公開番号　特開昭62-93915

(43)公開日　昭和62年(1987)4月30日

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(54)【発明の名称】軟磁性積層膜

【特許請求の範囲】

【請求項１】膜厚が５～10000Åの非磁性中間膜を介して２層以上の軟磁性の磁性薄膜が積層されて成り、これら各磁性薄膜は、総磁束が閉じる磁化量と膜厚に選定されると共に、上記各磁性薄膜は互いに同一の磁化容易軸方向を有することを特徴とする軟磁性積層膜。

【発明の詳細な説明】

〔産業上の利用分野〕

本発明は例えば各種薄膜磁気ヘッドにおける磁路を構成するヨークないしはコアに用いる軟磁性積層膜に係わる。

〔発明の概要〕

本発明は、非磁性中間層を介して磁性薄膜が積層された構造とすることによって、バルクハウゼンノイズの発生を回避する。

〔従来の技術〕

垂直磁気記録用単磁極ヘッド，誘導型磁気ヘッド，磁気抵抗効果型磁気ヘッド（以下ＭＲ型磁気ヘッドという）において、そのコアないしはヨークの少くとも一部を、磁性基体、或いは非磁性基体上に形成した軟磁性薄膜によって形成する薄膜型磁気ヘッドが広く用いられるに至っている。

通常、この種の磁気ヘッドにおける軟磁性薄膜は、単層構造による軟磁性薄膜が用いられている。

ところが、このような単層構造による軟磁性薄膜による磁気ヘッドでは、バルクハウゼンノイズが問題となる。これについて説明すると、この単層の磁性薄膜は、磁気異方性エネルギー，形状異方性等に起因する静磁エネルギー等の和が層全体として最小となるような状態を保持すべく第６図に示すような磁区構造をとる。この単層磁

性膜が長方形の磁性薄膜(51)であり、短辺方向に磁化容易軸を有する場合、その面内において、短辺方向に沿って磁化方向が交互に逆向きの磁区(52)が生じると共に、これら隣り合う磁区(52)に関して閉ループを形成するようにその両端間に磁性薄膜(51)の長手方向に沿って順次逆向きの磁区(53)が生じている。したがって、このような磁性薄膜(51)に外部磁界が与えられると磁壁(54)(55)が移動し、これによりバルクハウゼンノイズが発生する場合がある。

〔発明が解決しようとする問題点〕

本発明は、上述したバルクハウゼンノイズの発生を効果的に回避する。

〔問題点を解決するための手段〕

本発明は、第１図Ａ，Ｂ及びＣに示すように、非磁性中間膜(1)を介して２層以上の夫々軟磁性の磁性薄膜(2)を積層して軟磁性積層膜(3)を構成する。

非磁性中間膜(1)は、これを介して隣り合う磁性薄膜(2)間に、交換相互作用に比し静磁的相互作用が支配的に作用するような厚さ５～10000Å、好ましくは５～500Åに選定する。

また、各磁性薄膜(2)は、磁化容易軸を同一方向とするもので、夫々の飽和磁束密度、厚さ等の選定によって総磁束が閉じるようにする。すなわち、例えば、第１図Ａに示す２層の磁性薄膜(2)が非磁性中間膜(1)を介して積層された構造におては、両磁性薄膜(2)を例えば同一材料によって構成するときは、同一厚さとして、両者の磁束量を一致させて両磁性薄膜(2)に関して磁束が第１図Ａ中に矢印によって模式的に示すように全体的に閉じるようにする。また、第１図Ｂ及びＣに示すように３層以上の磁性薄膜(2)が非磁性中間膜(1)を介して積層した構造とするときは、両最外側の磁性薄膜(2s)に関しては、これら磁性薄膜(2s)を含めて全磁性薄膜(2)を同一材料によって構成するときは、磁性薄膜(2)のうち、両最外側の磁性薄膜(2s)を除くものについては同一厚さｔとし、両最外側の磁性薄膜(2s)については、ほぼｔ／２の厚さとする。

そしてこの構成による軟磁性積層膜(3)に対する磁界の印加、例えば磁気ヘッドのヨークないしはコアに適用した場合における信号磁界の印加は、その磁化困難軸方向とする。

〔作用〕

上述の本発明による軟磁性積層膜(3)によれば、バルクハウゼンノイズの発生が回避される。今、第１図Ａで示した２層の磁性薄膜(2)が非磁性中間膜(1)を介して積層された構造の軟磁性積層膜(3)についてみると、これに外部磁界が与えられていない状態では、第２図に示すように、両磁性薄膜(2)には、矢印M_1及びM_2で示すように夫々磁化容易軸方向e. aに互いに反平行の磁化状態にあって、磁壁が生じていない。このように磁壁が存在しないことについては、磁性流体を用いたビッター(Bitter)法による磁区観察によって確認したところである。そして、このような軟磁性積層膜(3)に対して、その磁化困難軸h. a方向に外部磁界Ｈを強めて行くと、第３図Ａ～Ｃにその磁化状態を、夫々の磁性薄膜(2)について、一方の磁性薄膜の磁化状態を実線矢印で示し、他方のそれを破線矢印で模式的に示すように、第３図Ａに示す第２図で説明した反平行の磁化状態から外部磁界Ｈにより、第３図Ｂに示すように回転磁化過程により磁化が回転し、更に強い外部磁界により、第３図Ｃに示すように、両磁性薄膜(2)が同一方向に磁化される。この場合、両磁性薄膜(2)は、その面内で回転磁化過程により磁化が回転するので、磁壁は生じることなくバルクハウゼンノイズの発生が回避される。つまり、両磁性薄膜(2)の磁化困難軸方向を磁束伝搬方向とすることによって磁壁移動に起因するバルクハウゼンノイズが回避される。

〔実施例〕

第４図を参照して本発明による軟磁性積層膜(3)を用いてヨーク型のＭＲ型磁気ヘッドを構成する場合の一例について説明する。

この場合、磁性基板(10)を用意する。この基板(10)は、例えばNi-Zn系フェライト、Mn-Zn系フェライト等の磁性基板より成る。基板(1)上には、この基板(1)が導電性を有する場合は、SiO_2等の絶縁性層(11)を形成し、これの上に通電によってバイアス磁界を発生するバイアス導体(12)を形成し、これの上に更に絶縁層(11)を介して磁気抵抗効果感磁部（以下ＭＲ感磁部という）(13)を形成する。

そして、このＭＲ感磁部(13)を挾んで、その前方及び後方、すなわち面(6)側とこれとは反対側との両端部上、絶縁層(11)を介してヨークの一部を構成する前方磁性層(14F)と後方磁性層(14B)とを形成する。後方磁性層(14B)の一部は、絶縁層(11)に穿設した窓(11a)を通じて磁性基板(10)に磁気的に密に結合させて、基板(10)－前方磁性層(14F)－ＭＲ感磁部(13)－後方磁性層(14B)－磁性基板(10)の閉磁路を形成するようにし、前方磁性層(14F)の前端部と基板(10)との間には、例えば絶縁層(11)による非磁性層の厚さによってギャップ長が規定された磁気ギャップｇが磁気媒体との対接ないしは対向面(15)に臨んで形成される。

この構成において、磁性層(14F)及び(14B)を本発明による軟磁性積層膜(3)によって構成する。厚さ500ÅのSiO_2膜より成る非磁性中間膜(1)を介して夫々厚さ1500ÅCo-Hf-Pdアモルファスの２層の磁性薄膜(2)を積層した第１図Ａで示した構造とする。或いは、第１図Ｂで示した構造として３層の磁性薄膜(2)の積層構造とし得る。この場合は、例えば中央の磁性薄膜(2)の厚さを2000Åとし、両外側の磁性薄膜(2s)の厚さを1000Åとし、非磁性中間膜(1)の厚さを100Åとし得る。或いは第１図Ｃで示した多層構造とすることもできる。

尚、これら磁性層(14F)及び(14B)の形成は、これらを構成する磁性薄膜(2)－非磁性中間膜(1)－磁性薄膜(2)…を順次連続した1連の作業で連続スパッタリング、或いは連続蒸着して軟磁性薄膜(2)を形成し、これをフォトリソグラフィ技術によってパターン化することによって同時に形成し得る。

尚、この場合、磁性層(14F)及び(14B)の軟磁性積層膜(3)の各磁性薄膜(2)は、その磁化困難軸方向が上述した磁性層(14F)及び(14B)を含む磁路において、その磁束の方向となるようにする。

また、本発明による軟磁性積層膜(3)によって、誘導型の薄膜磁気ヘッドを構成することもできる。この場合の一例を第5図を参照して説明する。この場合においても、例えば磁性基板(20)を用意し、これの上に必要に応じて絶縁層(21)を介して、ヘッド線輪(22)を例えば第1及び第2の導電体パターン(22A)及び(22B)を絶縁層(21)を介して積層して形成し、これらを横切る方向に、同様に第1図A～Cで説明した構成による軟磁性積層膜(3)によって帯状の磁気コアとなる磁性層(23)を被着形成する。この磁性層(23)は、第4図で説明した磁性層(14F)及び(14B)と同様の構成によることができる。そして、この磁性層(23)の後方端は、絶縁層(21)に穿設した窓(21a)を通じて基板(20)に磁気的に連接させる。前方端は、例えば絶縁層(21)より成る非磁性層をギャップスペーサとして基板(20)との間に所要のギャップ長を有する磁気ギャップgを形成し、この磁気ギャップgが磁気媒体との対接ないしは対向面(25)に臨むように形成する。このようにして、基板(20)－磁気ギャップg－磁性層(23)－基板(20)の閉磁路を有し、ヘッド巻線(22)を具備する電磁誘導型の磁気ヘッドが構成される。尚、この場合においても、磁気コアを構成する磁性層(23)における軟磁性積層膜(3)の各磁性薄膜はその磁束を通ずる方向が磁化困難軸方向とほぼ一致するように形成される。

〔発明の効果〕

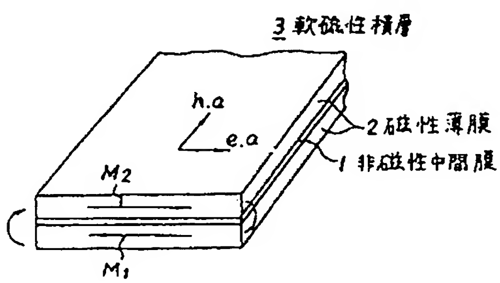
本発明によれば、軟磁性積層膜(3)において磁壁が生じないようにしたので、これによって磁気ヘッドを構成する場合は、バンクハウゼンノイズを効果的に回避できるので実用に供して、その利益は極めて大きい。

【図面の簡単な説明】

第1図A，B及びCは夫々本発明による軟磁性積層膜の各例の構造図、第2図は本発明による軟磁性積層膜の一例の磁化状態を示す図、第3図A～Cは軟磁性積層膜の外部磁界による磁化状態の説明図、第4図及び第5図は夫々本発明による軟磁性積層膜を用いた磁気ヘッドの各例の略線的断面図、第6図は単層構造の磁性薄膜の磁区構造を示す図である。

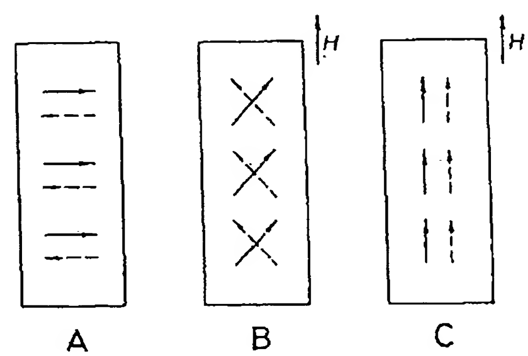
(3)は軟磁性積層膜、(1)は非磁性中間膜、(2)は磁性薄膜である。

【第2図】



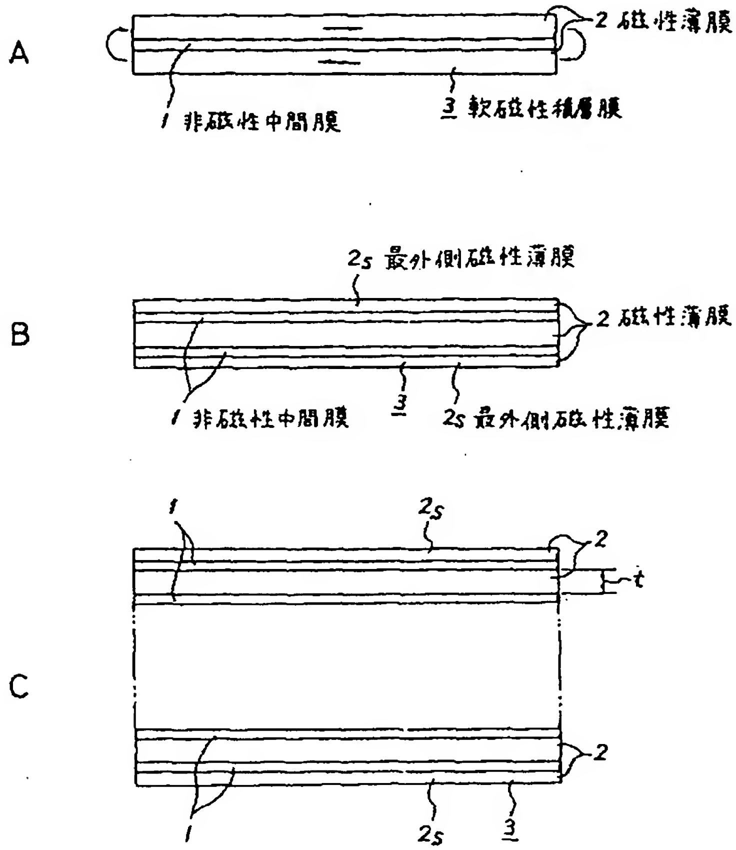
軟磁性積層膜の磁化状態を示す図

【第3図】



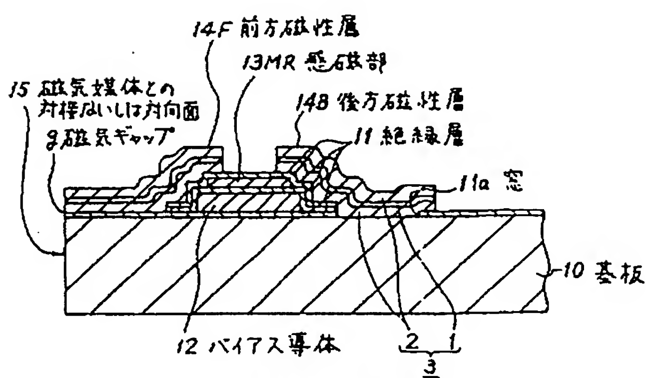
軟磁性積層膜の外部磁界による磁化状態の説明図

【第1図】



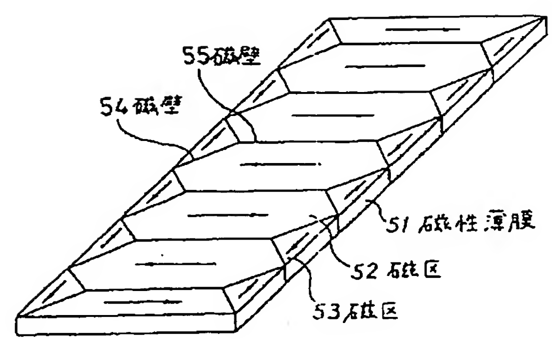
軟磁性積層膜の構成図

【第4図】



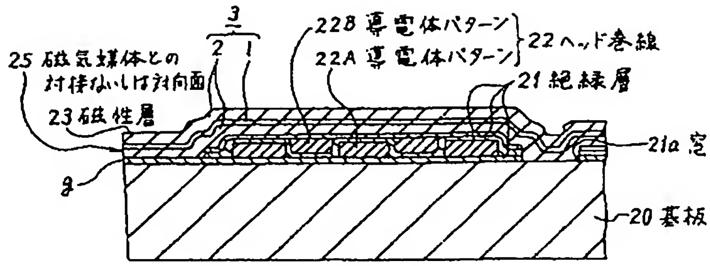
本発明による軟磁性積層膜を用いた磁気ヘッドの一例の略線的断面図

【第6図】



単層磁性薄膜の磁区構造を示す図

【第５図】



本発明による軟磁性積層膜を用いた
磁気ヘッドの他の例の略線的断面図